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REMARKS

Amendments to Claims

Claims 1-4 and 7-18 are pending. Claims 19-29 have been previously canceled under restriction requirement. Claims 1, 3-4 and 7-17 have been amended. Claims 2 and 18 are canceled herein.

Claim 1 has been amended to recite "a nozzle used in a printer for ejecting ink," rather than "a conduit" to more particularly define the invention. Support can be found on page 2, lines 6-12. The nozzle of this invention addresses the problem of nozzle function which is hindered by materials being adhered thereto (see page 1, lines 17-20) by coating with a durable fluid-repellent layer.

Claims 3-4 and 7-17 have been similarly amended to recite the "nozzle". Claim 4 has been amended to depend on claim 3 rather than canceled claim 2.

Remarks

Examiner rejected claims 1-4, 7-18 under 35 U.S.C. 103 (a) as being unpatentable over Diaz et al. (EP 0 195 292, hereinafter, "Diaz") in view of Iwato et al. (WO 01/90267, hereinafter, "Iwato")

Examiner asserts Diaz discloses a conduit having its surface or a portion of its surface coated with a fluid repellent layer wherein said layer comprises or is produced from a fluorocarbon silane, wherein said conduit is a nozzle (column 1, lines 28-65) (applies to instant claims 1-2). Applicant agrees.

Examiner concedes Diaz fails to disclose an aqueous emulsion, said emulsion comprises or is produced from a fluorocarbon silane or its hydrolysate, water and a surfactant, a silicon compound, a catalyst which is an acid or a base, said fluorocarbon silane has the formula R_f-$(CH_2)_p$-Si{-$(O$-$CH_2CH_2)_n$-OR^1}$_3$; said silicon compound is a silicate or an organoalkoxy silane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10, wherein the surface is metal or ceramic.

Examiner relies on Iwato for disclosure of an aqueous emulsion, which comprises or is produced from a fluorocarbon silane or its hydrolysate, water, a surfactant, a silicon compound, a catalyst which is an acid or a base, said fluorocarbon silane has the formula R_f-$(CH_2)_p$-Si{-$(O$-$CH_2CH_2)_n$-OR^1}$_3$; said silicon compound is a silicate or an organoalkoxy silane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; n is 2 to 10, wherein the surface is metal or ceramic (page 2, lines 22-33, page 3, lines 28-34, page 4, lines 16-33) (applies to instant claims 5-18) as coating for the purpose of providing improved heat resistance and water repellency properties. Applicant agrees with Examiner that Iwato discloses the aqueous emulsion so described and providing heat resistance and water repellency when used as a coating.

Examiner concludes it would have been obvious to one of ordinary skill in the art at the time applicant's invention was made to have provided an aqueous emulsion, said emulsion comprises or is produced from a fluorocarbon silane or its hydrolysate, water, a surfactant, a silicon compound, a catalyst which is an acid or a base, said fluorocarbon silane has the formula R_f-$(CH_2)_p$-$Si\{-(OCH_2CH_2)_n-OR^1\}_3$; said silicon compound is a silicate or an organoalkoxy silane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; n is 2 to 10, in the coating of Diaz on a surface which is metal or ceramic in order to provide improved heat resistance and water repellency properties as taught or suggested by Iwato. Applicant disagrees. Applicant respectfully asserts the properties of heat resistance and water repellency do not ensure that the coating would be durable and not hinder performance for a nozzle used in a printer for ejecting ink.

Applicant asserts unexpected results in terms of durability, e.g., to alkaline materials and abrasion-resistance are achieved by coating a nozzle with the aqueous emulsion claimed. Applicant referred in previous response to Albinson (EP 0 367 438 B1), Griffen (WO 96/06895) and Nakagawa (EP 1 386 951 A1) for state of the art of using fluorocarbon silanes for coating of inkjet nozzles. Each of these references teaches (1) fluorocarbon silanes are difficult to bond to the materials (polyimides, metal, etc.) used in nozzles and (2) when many fluorocarbon silanes are used as coatings, such coatings lack durability to alkaline materials and abrasive conditions.

Albinson teaches at column 2, lines 36-46 that certain fluorocarbon silanes do not adhere to plastic surfaces (as may be used in ink jet nozzles). Albinson teaches also at column 2, line 47 bridging to column 3, line 6, that fluorosilane-based coatings may be attacked by solvents used in inks and that such coatings are not abrasion-resistant.

Nakagawa teaches at paragraph [0008] a water-repellent film using a silane coupling agent lacks durability against alkalinity as is encountered in ink jet recording apparatus. Nakagawa at paragraph [0009] further teaches that silane bonding to surfaces by Si-O is easily hydrolyzed and the film disappears from the surface.

Examiner asserts the coated conduit is disclosed by Diaz and the references are analogous because both disclose fluorosilane coatings and Applicant cited both references as being related to the instant invention. Applicant argues herein even if analogous, the combination of Diaz and Iwato fail to teach or suggest Applicant's claimed invention.

Examiner provides that Applicant has argued that not all fluorocarbon silanes compositions are effective for use in printing. Examiner then asserts the fluorosilanes disclosed in Diaz and Iwato are "very similar in chemical structure thus indicating that the fluorosilanes of Iwato are compatible with printing applications". Applicant disagrees. Applicant respectfully asserts the film composition of Diaz is not very similar in chemical structure with the aqueous emulsion composition of Applicant's claims.

Diaz discloses coating an ink jet nozzle plate with a film comprising two ingredients: (1) a partially fluorinated silane and (2) a perfluorinated alkane. Diaz discloses at column 2, lines 10-13 use of trifluoropropylmethyldimethoxysilane, and at column 2, lines 25-27 alternative silanes of "perfluoropropoxypropylmethyldichlorosilane and dexamethyldisiloxane."

The structure of trifluoropropylmethyldimethoxysilane is as follows:

$F_3C\text{-}CH_2CH_2 - Si - (OCH_3)_2$

CH_3

It is clear this structure differs from the fluorocarbon silane of the emulsion. The only similarity is with the segment "R_f-$(CH_2)_p$-Si". The alternatives also differ, due to absence of chloro groups, and presence of methyl groups. In addition, there is no "R_f" group in "dexamethyldisiloxane", which may be a mistyping of "hexamethyldisiloxane", which has the formula of $(CH_3)_3 - Si - O - Si\ (CH_3)_3$. Thus, the fluorocarbon silanes of Diaz are NOT "very similar in chemical structure" to those in Applicant's claims.

Diaz further requires as a second ingredient, a perfluorinated alkane. There is no suggestion that such ingredient is present in the aqueous emulsion of Applicant's claims. In addition, Diaz fails to disclose or teach or suggest use of a surfactant, or a silicon compound or a catalyst or water in his film preparation, which are required components in Applicant's claims. Thus, the silane and other coating ingredients (surfactant, silicon compound and catalyst) of Applicant's claims are much different from the combined ingredients taught by Diaz.

Still further, to produce a film on the jet nozzle surface, Diaz teaches to deposit his ingredients (silane and perfluorinated alkane) by direct exposure to radio frequency glow discharge. In contrast, Applicant coats the nozzle by impregnation, dipping, coating, spraying or combinations of two or more thereof with optional heat treatment at 150-500°C for 1 minute to 10 hours (see page 5, lines 1-12 of Applicant's specification).

Thus, the coated nozzles of Diaz and Applicant's claims are (1) produced from different fluorocarbon silane-containing compositions and (2) are produced by different processes. Applicant respectfully asserts because of the differences, Diaz in combination with Iwato fails to teach or suggest the emulsions disclosed in Iwato are suitable for use for coating nozzles according to Applicant's amended claims.

Examiner asserts there is no disclosure in Iwato which teaches away from use of the emulsions disclosed therein in printing applications. Applicant asserts there is no disclosure or teaching or suggestion either that such emulsions would perform acceptably in nozzle applications. Since Diaz fails to suggest the emulsion composition of Iwato can be used in coating nozzles, Applicant respectfully asserts Iwato alone does not make obvious to one of ordinary skill in the art at the time Applicant's invention was made to have provided an aqueous emulsion as a coating on a nozzle. Iwato teaches use of emulsion as a coating on a surface which may be exposed to water and oil at high temperatures under essentially static conditions and in the absence of alkaline materials and abrasive conditions. Iwato fails to teach or suggest durability of a coated surface exposed to dynamic (i.e. movement of material through nozzle) alkaline and/or abrasive conditions.

Applicant asserts Albinson represents prior art to one skilled in the art of using fluorocarbon silanes to coat nozzles. Applicant respectfully directs Examiner to Albinson Comparative Example 2 (Albinson pages 13-14). The composition of this Comparative Example is more similar to that of Applicant's claimed emulsion (see Table below) than the composition of Diaz.

Table

Ingredient	Albinson – Comparative Example 2	Applicant's emulsion
Fluorocarbon silane	$CF_3(CF_2)_7CH_2CH_2$-Si-$(OCH_3)_3$	R_f-$(CH_2)_p$-Si{-$(OCH_2CH_2)_a$-OR^1}$_3$
Silicon compound	$Si(OC_2H_5)_4$	silicate or an organoalkoxysilane
Surfactant	-	Surfactant
Catalyst	HCl	Acid or base
Water	Water	Water

Applicant respectfully asserts Albinson Comparative Example 2 is "very similar in chemical structure" to the emulsion of Applicant's claims. More so than Diaz as cited by Examiner, Applicant respectfully asserts one skilled in the art would expect that the emulsion disclosed by Iwato would perform similarly as the composition of Albinson Comparative Example 2. Applicant respectfully directs Examiner to compare Applicant's Example 4 with Albinson Comparative Example 2. In Applicant's Example 4, a nozzle treated with Applicant's emulsion is exposed to N-methylpyrrolidinone (pH 7.7) for 120 hours (15 days at 8 hours per day). Applicant's treated nozzle showed excellent repellency and durability. In contrast, substrate coated a film in accordance with Albinson Comparative Example 2 was treated at pH 8 for 100 hours during which the film dissolved. Thus, Applicant asserts unexpected results for nozzle treated with the emulsion according to Applicant's claims.

Applicant respectfully asserts Albinson is closer art than Diaz and is inappropriate for Examiner to ignore. Applicant respectfully asserts the combination of Albinson and Iwato teach against Applicant's claimed invention.

Regarding performance under abrasive conditions, Applicant respectfully directs Examiner to Applicant's Example 1 wherein a ceramic nozzle is coated with emulsion of the invention and undergoes abrasion test, followed by use of the tested nozzle in an industrial inkjet printer. Good performance of the nozzle is reported – durable, based on substantially no change to contact angle, and no ink adherence to nozzle during test in printer.

Applicant's Example 3 illustrates nozzles coated with the claimed emulsion undergoes 100,000 repeated abrasions with significant improvement in durability. Again, while Iwato fails to teach against such advantageous results, Applicant respectfully asserts these results are surprising given the state of the art (e.g., Albinson, Griffen, Nakagawa), which suggests that many fluorocarbon silane compositions fail to meet durability for use in nozzle applications.

Thus, Applicant respectfully asserts the claimed invention is not merely "another advantage which flows naturally from the suggestion of the prior art" as Examiner asserts and the claimed invention is not obvious to one of ordinary skill in the art at the time Applicant's invention was made over Diaz (or Albinson) in view of Iwato.

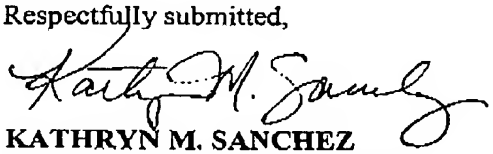
With regards to claims 3-4 as well as claims 7-17, as these claims rely on claim 1, they are also not obvious over Diaz in view of Iwato.

Conclusion

Applicants respectfully assert neither Diaz nor Iwato, nor the combination thereof teach or suggest use of the claimed nozzle having its surface coated with a substantially aqueous emulsion; said emulsion comprises or is produced from (1) a fluorocarbon silane or its hydrolyzate, (2) water, and (3) a surfactant, a silicon compound, and a catalyst which is an acid or base, or combinations of two or more thereof; said fluorocarbon silane has the formula R_f-$(CH_2)_p$-Si{-$(O-CH_2CH_2)_n$-OR^1}$_3$; said silicon compound is a silicate or an organoalkoxysilane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10 in a printer for ejecting ink wherein surprising improvements found in durability to exposure to alkaline conditions and abrasion resistance. Applicants assert the emulsion disclosed in Iwato is not applied to a nozzle surface. Furthermore, the coating of Diaz is not "very similar in chemical structure" to the coating of Applicant's claims.

In view of the foregoing, allowance of the above-referenced application is respectfully requested.

Respectfully submitted,



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